Matching Recruits to Jobs:

The Enlisted Personnel Allocation System

Special Report 41
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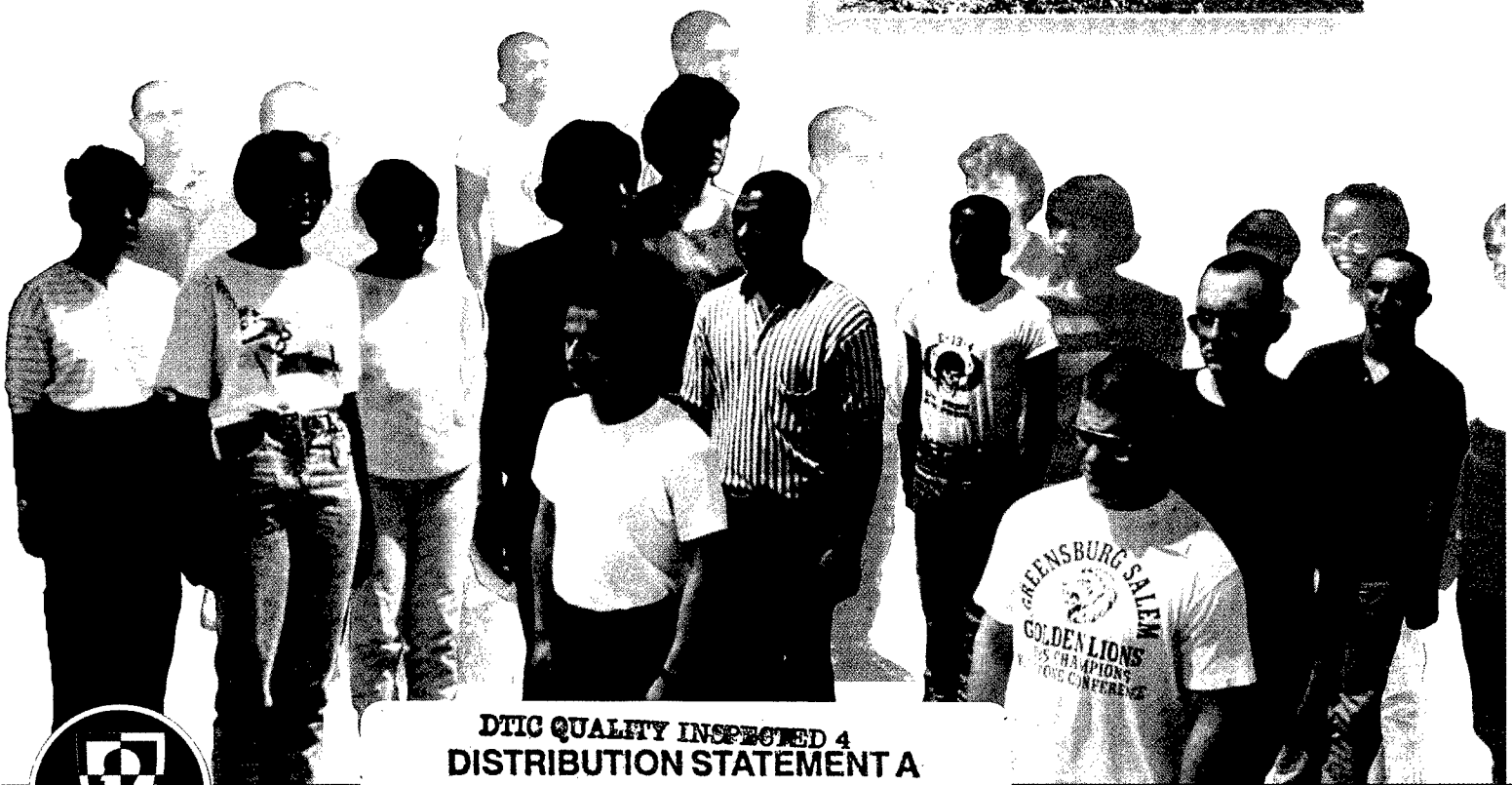

U.S. Army Research Institute for the Behavioral and Social Sciences

FOREWORD

Enlisted personnel classification has been a prominent part of ARI's research program. This report describes a major product of that research program – the Enlisted Personnel Allocation System (EPAS). It describes what EPAS can do and how it can be used to enhance the Army's current training reservation system (known as REQUEST). Field testing of EPAS is scheduled for FY 2001. It is expected that the Army will be able to use elements of REQUEST and EPAS together to yield significant improvements to the Army's enlisted personnel classification system.

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Director

Matching Recruits to Jobs:
Enlisted Personnel Allocation System

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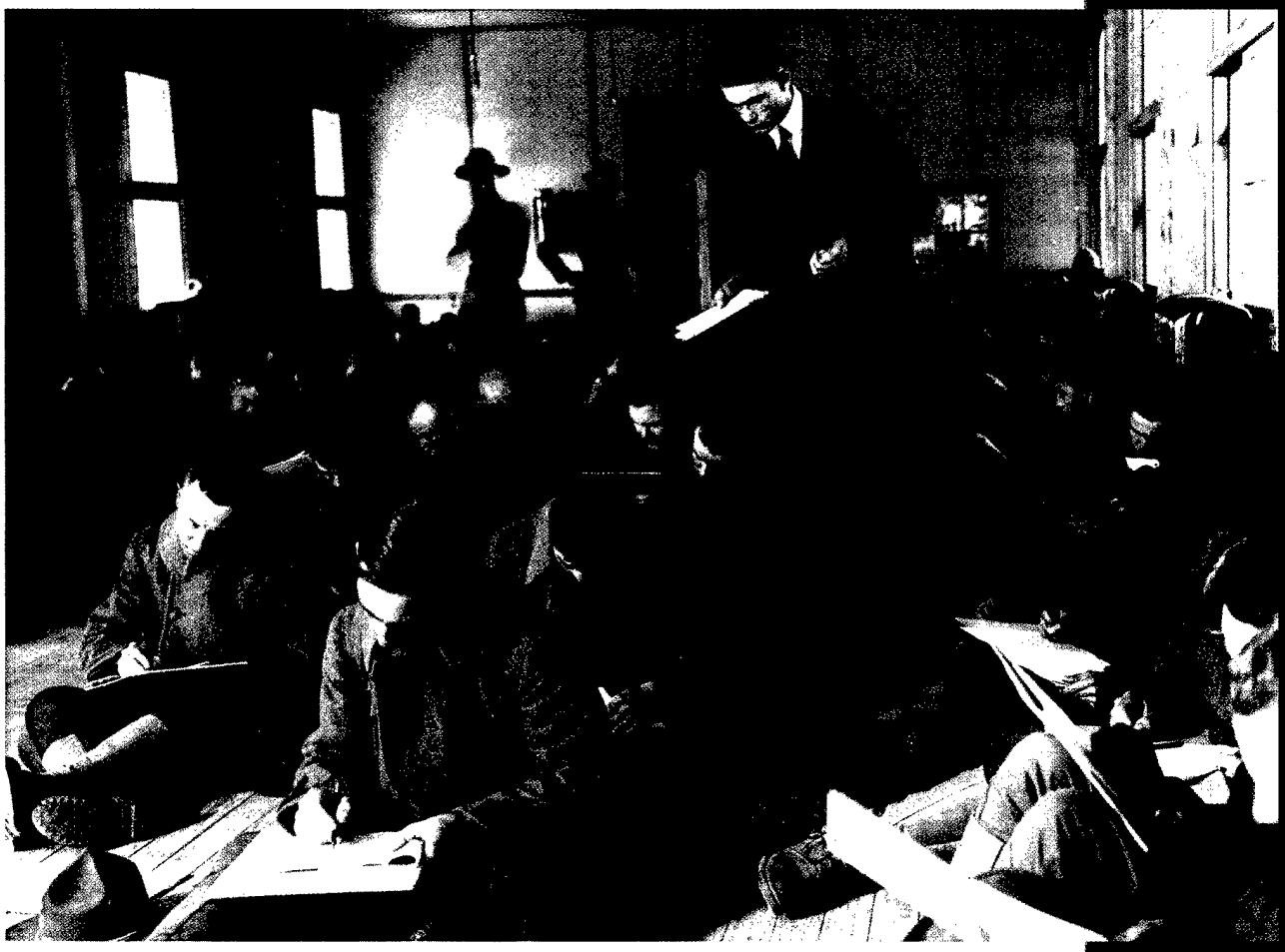
Background

The strength of the Army lies first and foremost in the effectiveness of its soldiers. Effective leadership, training, and equipment clearly enhance soldier performance, but they must be used in conjunction with soldiers who bring with them the right raw material. This is why the Army invests heavily in the selection and classification of its enlisted personnel.

Selection involves evaluating applicants for enlistment into the Army without regard to which job they should hold. The goal is to identify individuals who will make good soldiers – that is, who are trainable, in good physical condition, and of high moral character. Classification involves assigning each successful applicant (tens of thousands each year) into one of the large number of entry-level military occupational specialties (MOS).



Ideally, the Army classification system would effectively match individuals and jobs such that the performance of the total force will be maximized. At the same time, a number of critical human resource management conditions (e.g., making sure high priority MOS are filled) must be satisfied. In theory, there is an optimal solution to the classification problem based on linear programming techniques. In practice, all the necessary conditions for the optimal solution do not exist. It is the objective of any operational classification procedure to come as close as possible to the optimal procedure, given the constraints that any organization and group of applicants must face.

It is no small matter to maximize the effective selection and classification of Army enlisted personnel. The current enlisted selection system uses aptitude, education, physical, and moral restrictions to eliminate more than half of the applicants from eligibility to serve. This selection system is grounded in a rich history of research and experience dating back to World War I. The Army's classification system also is based on a history of research. But as we shall see, significant and exciting research strides in the classification area have recently been made that have yet to be tested out in the Army's operational system.

Though they work hand-in-hand to help assure that young men and women have what it takes to become effective soldiers, most people know more about the selection part of the enlistment process than they do about the classification part. This is probably because the selection piece is more visible to people. It involves testing and enlistment standards that are known by both Army applicants and Army personnel. It is also fairly easy to explain how the selection system works. On the other hand, discussing the conceptual framework and operational details of a classification system is much more complicated.

There are a variety of resources to learn about the Army's enlisted personnel selection process, including a 1996 Special Report[1] published by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). The 1996 report provides a non-technical, but thorough description of the past, present, and future of soldier selection. Both selection and classification in the Army have evolved from relatively simple beginnings to procedures that are closer to optimal. The evolution and development of the Army's classification procedures are what this report is about. Specifically, we provide a brief history and description of the current Army enlisted selection and classification system. Then we describe and discuss a new system (known as the Enlisted Personnel Allocation System, or EPAS) designed to substantially improve the classification part of the process. The report presents EPAS and its design for improving the effectiveness of the Army classification system. It compares EPAS to the current classification system (the Recruit Quota System – REQUEST), and discusses how they could be used together to improve the effectiveness of Army enlisted personnel classification. A more complete discussion of the theoretical and technical underpinnings of EPAS can be found in Greenston, McWhite, Mower, Walker, Lightfoot, Diaz, and Rudnik.[2]

Though some of the material presented herein is fairly technical in nature, this report is intended for a general Army management audience. The goals of the report will be achieved if it helps this audience understand the nature of the enlisted classification process more fully and appreciate the potential for improvements that could be made to that system.

A Brief Introduction to Army Enlisted Personnel Selection and Classification

Enlisted Personnel Selection

Though the focus of this report is on classification, it is important that the reader be familiar with its precursor in the enlistment process – selection. The purpose of enlisted personnel selection is to predict who in the pool of applicants is qualified for service and likely to complete the first term of enlistment. Selecting the right young men and women for military service is critical to the Army's mission and for maintaining the readiness of the force. Each year, over 150,000 young people consider the Army as a career option. Most applicants for active duty enlisted service hold at least a high school diploma. More than half are 18 years old or younger and approach the Army with little experience in the world of work.

How the Army Selection Process Works

The Army is concerned with the quality and strength of the force. Therefore, it seeks individuals who meet or exceed certain qualifications for service. Enlisted personnel selection is a decision-making process that consists of vocational aptitude testing, evaluation of educational background, a physical examination, and an assessment of moral qualifications (see Table 1).

- ✔ ***Vocational aptitude*** measured by the Armed Services Vocational Aptitude Battery (ASVAB), a group of 10 tests that predicts who will succeed in work-related training and perform productively and efficiently on the job.
- ✔ ***Educational credentials*** that project commitment to finish the first term of enlistment.
- ✔ ***Physical fitness*** for carrying out duties.
- ✔ ***Moral qualifications*** associated with principled military behavior and discipline.

Table 1
The Four Main Army Selection Screens

Vocational Aptitude Screening: The Armed Services Vocational Aptitude Battery (ASVAB). Typically an interested young person meets with an Army recruiter, who pre-screens the prospect. Sometimes the recruiter administers a brief screening tool called the Computerized Adaptive Screening Test (CAST) to get a feel for whether a prospect is likely to meet the minimum aptitude requirement. The recruiter may then elect to send the individual to a Military Entrance Processing Station (MEPS) or Mobile Entrance Testing Site (METS) for further processing. Most applicants begin the formal enlistment process by taking the ASVAB at a MEPS or METS. In some cases, however, applicants have already taken the test battery as part of the Department of Defense (DoD) High School Career Exploration Program.[3,4]

More than 80 years of military R&D and years of field experience have led to the development of the ASVAB, which has been used by all the Services for selection and classification decision-making since 1976.

Table 2 lists the aptitude content domains covered in the ASVAB and the specific subtests that measure each of them.

Content Domains		ASVAB Subtests
Verbal Aptitude	➡	Word knowledge (WK) Paragraph Comprehension PC) General Science (GS)
Quantitative Aptitude	➡	Arithmetic Reasoning (AR) Mathematics Knowledge (MK)
Technical Knowledge	➡	Auto/Shop (AS) Mechanical Comprehension (MC) Electronics Information (EI)
Perceptual Speed & Accuracy	➡	Coding Speed (CS) Numerical Operations (NO)

Table 2
ASVAB Vocational Aptitude Content Domains and Subtests

Vocational Aptitude Screening: The Armed Forces Qualification Test (AFQT). Two of the ASVAB verbal subtests (WK and PC) and the two mathematics subtests (AR and MK) form the AFQT, the primary military aptitude screen. AFQT is a measure of general cognitive aptitude. Research has consistently shown that general cognitive aptitude is the best single predictor of trainability and on-the-job performance for all occupations.[5] This evidence shows that AFQT is a highly effective selection device for the Services.

AFQT scores are used to group applicants into six "quality" categories (see Table 3). Congressional mandates and Army policy determine the proportions of applicants within each AFQT category that should be enlisted each fiscal year. The Army's current goal is to enlist 67% of its recruits from Categories I–IIIA; these individuals are above average in trainability and expected on-the-job performance. Applicants in Category IIIB are considered acceptable. Individuals in Category IV are carefully evaluated and have been accepted sparingly over the past two decades. In the early 1980s Congress mandated a 20% ceiling on Category IV accessions. Today, the Army tries to limit Category IV recruits to 2%. Category V applicants are barred by law from service.

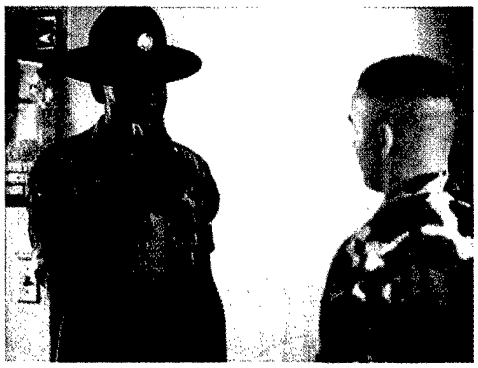
The proportions of young men and women in each AFQT category who actually enlist in the Army each year are also determined in part by the supply of applicants and the Army's requirements to fill MOS training opportunities. These considerations in turn depend upon numerous economic, social, and political factors. In a recruiting market favorable to the Army (i.e., when the supply of applicants exceeds the Army's needs), policymakers are more stringent in setting entrance quality standards. The reverse is true in a poor recruiting market like that of the late 1990s, though the Army cannot dip below the standards set by law.

Table 3
AFQT Categories and Percentile Scores

AFQT Categories	AFQT Percentile Scores
Category I	93-100 percentile
Category II	65-92 percentile
Category IIIA	50-64 percentile
Category IIIB	31-49 percentile
Category IV	10-30 percentile
Category V	1-9 percentile

Educational Screening. The Army prefers applicants who hold at least a regular high school diploma. This is because evidence consistently indicates that high school diploma graduates are more likely to adjust satisfactorily to military life and complete their first term of enlistment than are high school non-graduates and those holding alternative credentials. The Army's current goal is for at least 90% of recruits to have high school diplomas. With few exceptions, applicants without a high school diploma must be in AFQT Categories I–IIIA to be enlisted.

Physical and Moral Screening. After completing the aptitude and educational screens, each applicant is screened for medical conditions and problematic past behavior to ensure he or she possesses the ability to



withstand the demands of being a soldier. The applicant is given physical examinations to identify medical problems and assess physical condition.

If the applicant passes the aptitude, educational, and physical screens, then he or she is given a final moral screen. Moral screening at this stage consists of a background check and an interview with a career counselor. Individuals who meet all requirements are deemed acceptable for service and pass on to the second phase of the enlistment process, and the focus of the remainder of this report: classification. (In practice, the selection and classification phases overlap.)

Enlisted Personnel Classification

A Brief History of Army Classification

The Beginnings of Classification in World Wars I and II. The need for an effective military person-job matching process was recognized during World War I by field commanders who informally used Army Alpha and Beta selection test[6] results to evaluate soldiers' strengths and weaknesses relative to the jobs that needed to be filled. This is the essence of person-job matching, which is also referred to as personnel classification.

During World War II, military psychologists realized that new technologies and military equipment created more complexity and greater specialization in military jobs than existed during World War I. They responded to these changes by devising new employment testing methods that went beyond the simple selection techniques based on the Alpha and Beta tests. One of the most important efforts was an investigation of the use of a multiple aptitude test battery (a precursor of the ASVAB) for scientifically matching soldiers to military specialties. This was an important extension of the common sense approach to person-job matching spontaneously used in the field during World War I, and exemplifies the close association of practice and science in applied personnel psychology.

There are few records of the first classification testing efforts, probably because the emphasis was on meeting critical wartime needs. The Army Air Forces Aviation Psychology Program of World War II documented some of the earliest classification studies, which were aimed at assigning aircrew officers to pilot, navigator, and bombardier specialties.[7] Closely following the end of World War II, a small group of military and university psychologists who

Hubert E.Brogden

assisted in the selection, classification, and training of soldiers during the war began to formalize classification theory and define the statistical specifications of a classification technology.[8] Hubert E. Brogden, Chief Scientist in the 1950s of ARI's predecessor organization, laid out the theoretical foundation of classification, which stands today. Brogden is still regarded as one of the foremost personnel classification scientist-practitioners.[9]

Personnel Classification: An Expansion in Concept. Originally personnel classification was simply conceived as the assignment of each new person to the job for which he or she was best suited, based on a valid assessment of the person's aptitudes and other personal characteristics related to job performance. Over the years the concept of personnel classification was broadened to reflect more general aspects of the employment, or enlistment, process. These include other organizational requirements (e.g., staffing hard-to-fill jobs, filling available training seats) and applicant considerations (e.g., career interests, desired entry dates). The expanded definition accepted today is that classification is the matching of applicants to one of numerous jobs in a manner that enhances aggregate productivity and individual performance, while efficiently managing other enlistment requirements and meeting general applicant career needs.

The Evolution of Operational Classification Systems. Despite the importance of classification to the military enlistment process, relatively simplified operational classification testing systems had to be developed by the Services in the early 1950s, each designed to meet the unique needs of the particular Service.[10] Simplified testing procedures were necessary because early computer technology was incapable of performing the complex statistical analyses and simulation studies required to develop and evaluate sophisticated, operational person-job matching testing procedures.

Computerized job assignment and training reservation systems, such as the Army's Recruit Quota System (REQUEST), were introduced in the mid-1970s. These systems implemented basic person-job matching processes, while including increasingly efficient procedures for meeting organization-wide enlistment requirements (e.g., efficiently managing MOS training opportunities and recruit entry dates) as computer technology improved.

The 1990s brought advances in classification methods, which were fueled by the enormous progress in computer technology and a series of R&D programs. A large proportion of this work was sponsored by ARI.[1, 10-19] The studies produced a strong, comprehensive body of positive laboratory findings that provided the impetus for ARI to develop EPAS.[2, 20] The purpose of EPAS is to improve the effectiveness of the Army classification process as it is currently implemented by REQUEST, without reducing the efficiency of the training reservation system.

Army Classification Criteria

Before describing EPAS further, the current Army classification system implemented by REQUEST is described in more detail. This system is based upon the procedures developed in the early 1950s and consists of the following elements:

- ✔ nine groups of entry-level MOS called Aptitude Areas;
- ✔ corresponding Aptitude Area composite scores (sometimes called line scores); and
- ✔ minimum job assignment qualifications for each entry-level MOS.

MOS were grouped into nine Aptitude Areas based on similarity of aptitude and technical information requirements. Each Aptitude Area is associated with an Aptitude Area composite score, which is a simple sum of three or four ASVAB subtest scores. The Aptitude Area composite scores are estimates of future success in entry-level training and performance in the MOS included in a given Aptitude Area.

Table 4
Army Aptitude Areas and Composites

Aptitude Areas	Aptitude Area Composites of ASVAB Subtests[a,b]
Clerical	VE + AR + MK
Combat	CS + AR + MC + AS
Electronics Repair	AR + MK + EI + GS
Field Artillery	CS + AR + MC + MK
General Maintenance	MK + EI + GS + AS
Mechanical Maintenance	NO + EI + MC + AS
Operators/Food	NO + VE + MC + AS
Surveillance and Communications	AR + MC + VE + AS
Skilled Technical	VE + MK + MC + GS

[a]AR = Arithmetic Reasoning; AS = Auto & Shop Information, CS = Coding Speed, EI = Electronics Information, GS = General Science, MC = Mechanical Comprehension, MK = Mathematical Knowledge, NO = Numerical Operations, PC = Paragraph Comprehension, and WK = Word Knowledge, VE = Verbal (PC & WK).

[b] Aptitude Area composite scores are formed by summing the scores from the ASVAB subtests that make up that composite. Composite scores are standardized with a mean of 100 and a standard deviation of 20.

Applicants who pass the selection screens receive an Aptitude Area composite score (in addition to the AFQT score) for each of the nine Aptitude Areas. Table 4 lists the Aptitude Areas and Aptitude Area composites associated with them.

Each of the nine Aptitude Areas is subdivided into smaller sets of MOS having the same minimum qualifying, or cut-off, score for the associated Aptitude Area composite. The minimum qualifying scores are determined by the MOS proponent school based upon the relationship of an Aptitude Area composite with classroom training performance. An applicant must meet minimum qualification to be eligible for assignment for particular MOS training. In addition, some MOS have other requirements, such as a specific high school math course.

Few modifications have been made to the Army's classification process over the years other than evolutionary changes to the ASVAB and periodic modifications to the make-up of the Aptitude Area composites

Table 5
Example of MOS in a Single Aptitude Area with Different Minimum Qualifications

Aptitude Area	Sample MOS	Aptitude Area Composite Cut-Off Scores
Mechanical Maintenance	63Y Track Vehicle Mechanic 67N Utility Helicopter Repairer 68B Aircraft Powerplant Repairer	100
	61B Watercraft Operator 63E M1 Abrams Tank Systems Mechanic	95
	62B Construction Equipment Repairer 63W Wheel Vehicle Repairer	85

and minimum qualifying scores. Raising or lowering MOS qualifications depends upon a number of factors, such as the labor supply and demand for that and other MOS, the difficulty of the job, and the overall quality of the Army applicant pool. Table 5 presents a sample of MOS in the Mechanical Maintenance Aptitude Area with a range of different cut-off scores. The Aptitude Area composite score used to assess eligibility is the same for all MOS within this Aptitude Area—only the minimum qualifying scores vary. This is also the case for the other eight Aptitude Areas.

How the Army Classification Process Works

The Army Automated Classification System: Recruit Quota System. Following selection screening, an Army career counselor uses REQUEST to work with a successful applicant to choose an MOS and training start date. REQUEST is a real-time person-job matching and training reservation system. It functions much like an airline reservation system by identifying which MOS have vacancies for qualified applicants and when training opportunities will be open for those jobs. The U.S. Total Army Personnel Command (PERSCOM) centrally manages REQUEST. Army career counselors are linked to the REQUEST server through personal computers.

The REQUEST server provides the career counselor with a list of possible assignments specifically generated for each applicant. The counselor uses this list as the basis for negotiating the MOS assignment. The list contains 25 MOS for which the young person is qualified and which have training start dates that are acceptable to the applicant. The list is ordered to give high priority to critical and hard-to-fill MOS.

The REQUEST system supports both aspects of the Army's classification process—effective classification and meeting Army-wide enlistment requirements. But the emphasis is on meeting Army-wide enlistment requirements, given that recruits (technically applicants until the enlistment contract is signed) meet minimum MOS requirements. The main inputs are:

- ✔ The individual's nine Aptitude Area composite scores, AFQT category, and education level;
- ✔ Aptitude Area composite score minimum qualifications for entry MOS;
- ✔ Any other MOS-specific qualifications or restrictions (e.g., high visual acuity, the ability to swim, a security clearance, high school course requirements, combat MOS gender restriction);

- ✔ The individual's window of availability for reporting to duty;
- ✔ The current set of open, critical, and hard-to-fill MOS;
- ✔ The status of MOS fill rates;
- ✔ MOS training needs, which take into account MOS criticality, other Army priorities, MOS popularity, current training opportunities, and remaining annual training requirements;
- ✔ MOS training class start dates;
- ✔ The status of recruits in the Delayed Entry Program (DEP); and
- ✔ The status of the distribution of highly qualified new recruits (i.e., high school graduates in AFQT Categories I-IIIA) across all entry MOS.

Negotiating the Applicant's MOS Assignment. Aided by the REQUEST assignment list, the career counselor's main responsibility is to meet the Army's critical operational requirements. Balancing Army requirements and applicant desires, career counselors use their knowledge of the Army, their experience with the REQUEST system, and information about the applicant (e.g., educational background and interests) to help guide the young person's MOS choice.

In general, Army applicants are motivated to choose an entry level MOS that is a good match with their interests, gives them transferable skills for the civilian sector, allows them to take advantage of special programs and enlistment benefits and bonuses for which they qualify, and/or has training opportunities available at the time they want. The counselor has the flexibility to run REQUEST in "look-up mode" when the individual has a preference for a particular MOS or entry date.

Finalizing the Enlistment Process. The career counselor and soon-to-be new recruit work through the REQUEST list of 25 MOS/training-start-date combinations until the applicant chooses one. Then the counselor makes the reservation and guides the applicant through signing the enlistment contract, which states the specific MOS assignment. The REQUEST reservation is automatically recorded in the REQUEST server, which updates MOS training opportunities in real-time. The recruit is immediately sworn in to the Army and placed in the Delayed Entry Program (DEP).

The DEP is a way station for enlistees while background checks are made, medical test results received, training opportunities become available in the chosen MOS, or the recruit finishes high school. Many enlistees in the DEP are high school seniors whose in-processing is on hold until they graduate. New recruits can remain in the DEP for a matter of days or for a period of up to 12 months.

On the specified date, the new recruit reports for entrance processing and to begin training. After initial training the new soldier takes on the MOS assignment in a field unit where learning continues and he/she begins to make a productive contribution to the Army's mission and readiness. The success of all this, as previously discussed, depends in large part on the effectiveness with which individuals have been matched to specific jobs.

EPAS: A Method for Improving the Army's Classification System

The latest tool available to the Army for improving the classification process is the Enlisted Personnel Allocation System (EPAS). Designed to be a subsystem of REQUEST, EPAS is a classification tool that optimizes the assignment of recruits to entry-level MOS. EPAS goes beyond the Army's present approach to person-job matching (i.e., identifying high priority MOS for which an applicant meets the minimum Aptitude Area composite score qualifications). In contrast, EPAS identifies those MOS in which the individual is likely to perform with the greatest effectiveness, while meeting the Army's accession goals and filling critical MOS.

The EPAS tool was initially developed through a 4-year R&D project conducted by ARI in the 1980s.[20] A personal computer-based EPAS (PC-EPAS) prototype was created and evaluated with laboratory simulations of the Army's classification process in FY 1998.[2] Based on the positive results of the 1998 study, ARI developed an operational version of EPAS in FY 2000, which will be field tested in FY 2001.

Integrating EPAS with REQUEST has potential benefits for both the Army and the soldier. The Army will gain through the higher potential for training and job success of all recruits. Soldiers will gain because the better match of their aptitudes to MOS requirements gives them a higher potential for career success. The cumulative results of laboratory classification studies conducted during the late 1980s and 1990s provide strong evidence that EPAS can improve the average Aptitude Area composite score of an annual recruit cohort, while simultaneously meeting priority Army enlistment requirements.[2, 14, 18, 21, 22] The planned field test will evaluate whether the laboratory findings can be realized by the Army's operational enlistment system.

In addition to the operational classification method, EPAS includes a planning module that can be used independently or along with REQUEST to conduct a wide range of "what if" recruiting supply and demand scenarios. This type of tool is invaluable to policymakers and managers for anticipating the potential effects of changes in the Army's applicant population, organizational priorities, and many other factors that contribute to the complexity of the recruiting, selection and classification processes.

Table 6
Comparison of REQUEST and EPAS Classification Strategies

REQUEST		EPAS
Primary goal: Filling critical Army MOS	◀▶	*Primary goal:* Maximizing cohort Aptitude Area composite scores while meeting accession goals
Sequential assignment process	◀▶	Batch assignment process
Assignments meet minimum Aptitude Area requirements	◀▶	Assignments based on greatest Aptitude Area composite score
Assignments consider aptitudes of current applicant only	◀▶	Assignments based on predicted aptitude distribution of applicant pool

Alternative Classification Strategies Used by REQUEST and EPAS

REQUEST and EPAS represent different strategies for assigning qualified recruits to Army MOS. Table 6 enumerates some of the most salient differences between the methods. REQUEST uses a sequential assignment process. In general, this classification procedure is designed to assign each recruit to the highest priority MOS for which he or she meets the minimum Aptitude Area composite cut-off score, regardless of the individual's scores for other MOS or the scores of other recruits in the applicant pool. Although this process ensures that critical Army needs are met to the greatest extent possible, it may assign an applicant to an MOS for which he or she is marginally qualified, when there is another job in which the applicant would perform at a much higher level.

EPAS, on the other hand, employs a batch assignment process. This strategy is designed to assess all recruits for all MOS vacancies during the fiscal year, and to assign each recruit to the MOS for which he or she has the highest or near highest Aptitude Area composite score, as long as it meets the minimum cut-off. The goal of EPAS is to maximize the job performance of an annual recruit cohort. For this to be operationally feasible, EPAS bases assignments on the expected distribution of aptitudes in the cohort. EPAS divides the applicant population into 127 "supply groups" with similar demographic characteristics and Aptitude Area composite scores. Individual applicants are offered job opportunities based on the supply group they most closely resemble.

To highlight the differences between the two procedures and to describe how EPAS can improve the effectiveness of REQUEST, we present two simplified person-job matching methods that illustrate the basic principles of the two classification systems. The first method is a sequential assignment process that represents a simplified version of REQUEST. The second is a batch assignment process that is a simplified version of the EPAS procedure. Although both of these descriptions greatly reduce the complexity of the classification process, they highlight some of the critical differences between the two approaches.

A Hypothetical Sequential Classification Process

Figure 1 presents the results of a sequential classification procedure which is based on meeting minimum qualifications. The left side of the figure shows three hypothetical recruits and three vacancies in the high priority MOS for which they are being considered. The recruits are ordered by the time that they applied, while the MOS are ordered by their priority. Each arrow represents the person's estimated performance score for the MOS to which it is connected. The performance estimates are Aptitude Area composite scores.[23] The scores appear above the lines. For example, Recruit P_1 has a passing Aptitude Area composite score of 95 for MOS-A, but ineligible scores of 80

and 75 for MOS-B and MOS-C.

The right side of Figure 1 shows the MOS that was assigned to each recruit, and the relevant estimate of performance that was obtained from the assignment. The Index of System Efficiency shown at the bottom of the figure is the average Aptitude Area composite score for the recruits in their assigned MOS. This is an indicator of the effectiveness of the classification process.

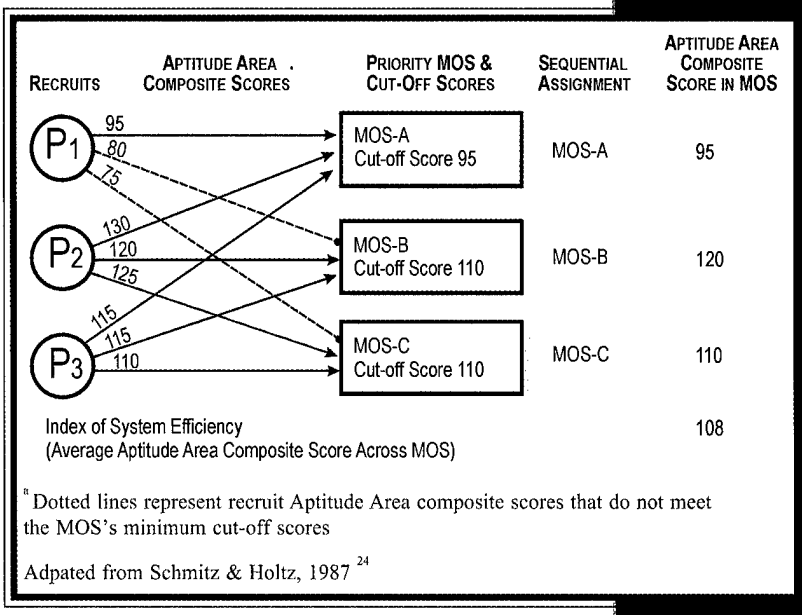


Figure 1. Hypothetical Sequential Classification Process.

The results of the hypothetical sequential assignment process in Figure 1 were as follows:

- ✔ First, Recruit P_1 was assigned to MOS-A, which was both the most critical MOS and the only MOS for which P_1 was qualified.
- ✔ Then, Recruit P_2 was assigned to MOS-B. This recruit was qualified for all three MOS, but was assigned to the highest priority MOS that was not already filled (even though he had higher Aptitude Area composite scores for MOS-A and MOS-C).
- ✔ Finally, Recruit P_3 was assigned to MOS-C, the only MOS that was not already filled (even though he had higher Aptitude Area composite scores for MOS-A and MOS-B).

The sequential classification process produced an Index of System Efficiency of 108 in this example. To help interpret this number, the average value of the index over the six possible ways that these three recruits could be assigned to the three MOS is approximately 107.

A Hypothetical Batch Classification Process

Figure 2 depicts a simplified version of a batch assignment procedure that possesses the essential characteristics of EPAS. The procedure simultaneously assesses all three recruits for all three MOS vacancies. It then attempts to assign each recruit to the MOS for which the individual has the highest Aptitude Area composite score, as long as the score is above the minimum qualification.

The right side of Figure 2 presents the results of the hypothetical, batch process.

- ✔ Recruit P_1 was assigned to the only MOS for which he was eligible.
- ✔ Recruit P_2 was assigned to his second best job, MOS-C. He had the highest score among the three recruits for this MOS, making it a good match when the full applicant group was considered.
- ✔ Recruit P_3 was assigned to MOS-B, one of the two jobs for which he had scores above the cut-off.

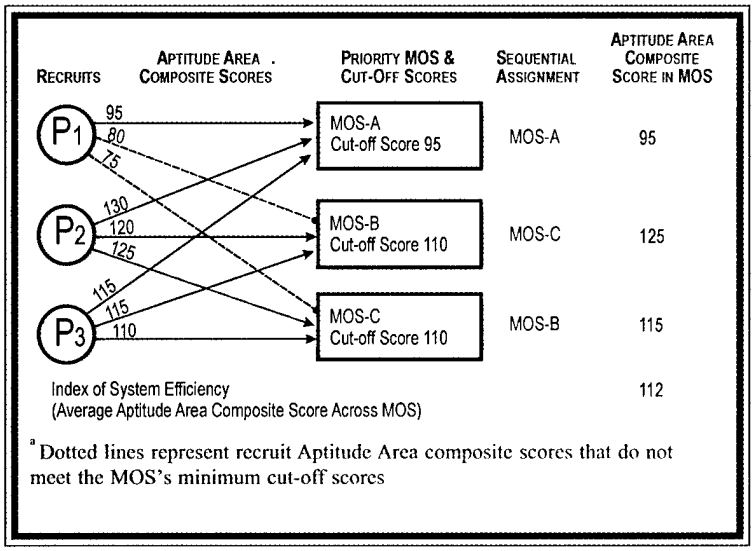


Figure 2.
Hypothetical Batch Classification Process.

This classification process is *near-optimal*, rather than optimal, because of the requirement to fill every job vacancy. When the number of vacancies is equal to the number of applicants, it may not be possible to assign all individuals to their most suitable job because of competition from other people with equal or better qualifications. A *purely optimal* classification process would require the flexibility to assign every person to the most suitable job, which is operationally unrealistic. Nevertheless, for the example in Figure 2, the batch process produced an Index of System Efficiency of 112, which is 4 points higher than the comparable value for the sequential process and is the maximum value that can be obtained for these three recruits and MOS under the assignment constraints.

Batch assignment processing is a technique designed to provide the best overall recruit matches. It does so through intra-individual and inter-individual comparisons of Aptitude Area composite scores. Intra-individual comparisons take place across all MOS—each recruit's composite scores for every MOS are evaluated in terms of the magnitude of the scores and whether they meet the minimum qualifications. An example of the effect of intra-individual comparison of scores on the classification process is the assignment of Recruit P_3 to MOS-B, instead of MOS-C, because his score was higher for MOS-B.

Inter-individual comparison refers to the process of evaluating the Aptitude Area composite score of every recruit against those of all other recruits for each MOS in the classification process. An example of this is the assignment of Recruit P_2 to MOS-C because his score was higher than Recruit P_3's score, which was at the cut-off. Taken together, the three assignments in Figure 2 demonstrate the interplay of intra- and inter-individual comparisons in a batch person-job matching process.

Classification Procedures in an Operational Environment

The assignment processes demonstrated in Figures 1 and 2, though oversimplifications of the Army's operational classification procedures, reflect the major principles of each approach. REQUEST currently employs a more complex version of the sequential process shown in

Figure 1, while EPAS uses a variant of the batch process illustrated in Figure 2.

Operational classification procedures must deal with numerous complexities of the recruiting environment that are not represented in these simplified examples. Recruits have many opportunities available to them, and may choose from among several MOS for which they are qualified. The effect of recruit choice on the efficiency of the classification process in an operational environment is unknown at this time. Furthermore, recruits are not assigned in batches, but apply for enlistment individually. Consequently, the batch method must be modified to be feasible in an operational environment. EPAS has solved this problem by applying the batch process to segments of the recruit population, termed supply groups, with similar demographic characteristics and aptitudes.

Benefits and Limitations of Alternative Classification Strategies Used by REQUEST and EPAS

Although the sequential and batch classification strategies have both benefits and limitations, the relative ability of the procedures to maximize aggregate Aptitude Area composite scores while meeting Army accession requirements in an operational environment is unknown. The planned ARI field test to be conducted in FY 2001 will provide information necessary to determine the operational efficiency of REQUEST and EPAS. Laboratory studies of the two types of classification processes have found substantially higher classification system efficiency for the batch processing approach over the sequential, minimum qualifications procedure. The gains in Army-wide, average Aptitude Area composite scores found in the laboratory suggest that operational use of a batch processing approach to classification could increase performance at a much lower cost than increasing selection standards.[14]

Both REQUEST and EPAS focus on important, but somewhat different, aspects of the classification process. Consequently, it is not surprising that they have somewhat different benefits and limitations, as illustrated in the following discussion.

Benefits and Limitations of REQUEST

REQUEST has two main strengths. The first is that the REQUEST sequential process is designed to output in real-time a selection of 25 MOS assignments with training start dates. However, it is limited to evaluating each recruit for only the presently available set of MOS. Unlike EPAS, it cannot capitalize on the individual differences in aptitude profiles among recruits in an annual cohort or the projections of MOS vacancies and training opportunities.

The second strength of REQUEST is that, in addition to meeting minimum MOS qualifications, the REQUEST assignment procedure

places strong weight on efficiently managing Army-wide enlistment requirements. These include meeting accession goals, filling high priority and hard-to-fill MOS, efficiently populating entry training classes throughout the year, distributing highly qualified recruits equitably across all MOS, and managing the supply of recruits in the DEP. These needs must be and are heavily weighted in the REQUEST classification procedure. This helps in the smooth operation of recruiting and enlistment processes throughout the fiscal year.

Benefits and Limitations of EPAS

The first benefit of EPAS is that it uses the actual magnitude of Aptitude Area composite scores, in addition to minimum qualifications, in making assignments just as in the example in Figure 2. Therefore, the Index of System Efficiency of EPAS for an annual recruit cohort would tend to be higher than that produced by the REQUEST sequential procedure, which uses only minimum qualifications to determine assignments. The FY 2001 field test of operational EPAS will evaluate whether EPAS improves upon the classification effectiveness of REQUEST under realistic operational conditions.

The second benefit of EPAS is that it employs a batch classification strategy. To capitalize on the utility of batch processing, EPAS uses contract missions prepared by Army Recruiting Command (USAREC) as a forecast of enlistment contracts, and accession goals and MOS training requirements prepared by the Directorate of Military Personnel Management (DMPM) of the Office of the Deputy Chief of Staff of Personnel (ODCSPER). Enlistment forecasts are broken down into 127 supply groups of potential recruits with specific demographic and ASVAB test composite profiles. The profiles are defined in terms of AFQT categories, education, gender, and Aptitude Area composite scores.

EPAS works with monthly accession goals and MOS training requirements, available training seats, and enlistment forecasts by supply group over an annual planning horizon using a batch classification procedure. A list of near-optimal assignments to projected MOS training vacancies is generated for the current month's (expected) enlistments for each supply group. The EPAS lists of assignments are referred to as EPAS Optimal Guidance. The job possibilities are ranked from high to low in terms of an EPAS Index of System Efficiency. The potential MOS assignments, each considered good matches from the Army's perspective, will provide recruits with a range of career opportunities. They can choose one that is the closest fit with their career interests and/or is associated with enlistment bonuses or special programs they value.

The limitation of the EPAS classification process is that it produces lists of near-optimal assignments for forecasted recruit supply groups, not actual recruits. When used operationally, a recruit would have to be placed into the supply group for the appropriate demographic category with the closest Aptitude Area composite score profile. Placing recruits in supply groups slightly reduces the efficiency of the EPAS process. However, this reduction is counterbalanced by the general benefits of batch processing. The planned field test will also provide data on
this issue.

Integration of REQUEST and EPAS

The benefits of EPAS complement those of REQUEST and suggest that there may be substantial advantages to integrating the two systems. A procedure for integrating EPAS into REQUEST is to run the EPAS batch classification process alongside the sequential process of REQUEST. The EPAS Optimal Guidance assignment list for a selected recruit supply group would be merged with the REQUEST assignment list for a particular recruit who fits that supply group profile. One possible merging strategy is that the EPAS Optimal Guidance would be used to reorder the 25 REQUEST assignments from highest to lowest in terms of an EPAS Index of System Efficiency. This approach would capitalize upon the EPAS near-optimal batch processing technique based on Army enlistment forecasts and MOS training requirements.

Where there are discrepancies between the two lists of assignments, the non-overlapping EPAS assignments would be dropped, while the non-overlapping REQUEST assignments would be retained and placed at the bottom of the list in the order in which they were output by REQUEST. This would ensure that critical enlistment requirements are given appropriate consideration in the integrated REQUEST-EPAS classification system. The resulting hybrid, sequential-batch classification process would retain the strengths of the independent REQUEST and EPAS procedures, while minimizing their weaknesses. The FY 2001 operational field test will be used to evaluate this and other potential strategies for integrating the REQUEST and EPAS assignment lists.

REQUEST-EPAS Classification System

The following description of a REQUEST-EPAS classification system is directed to readers who would like to have a detailed understanding of the operational concept. Other readers may want to proceed to the section on second generation improvements to EPAS and REQUEST.

Figure 3 graphically depicts the integration of the EPAS subsystem into REQUEST. The model consists of inputs for both EPAS and REQUEST, the assignment processes unique to each system, and their outputs, which are merged into a single list of 25 MOS-training assignments for a particular recruit. The career counselor would use the Merged REQUEST-EPAS Assignment List as the basis for helping a recruit choose a MOS and training start date.

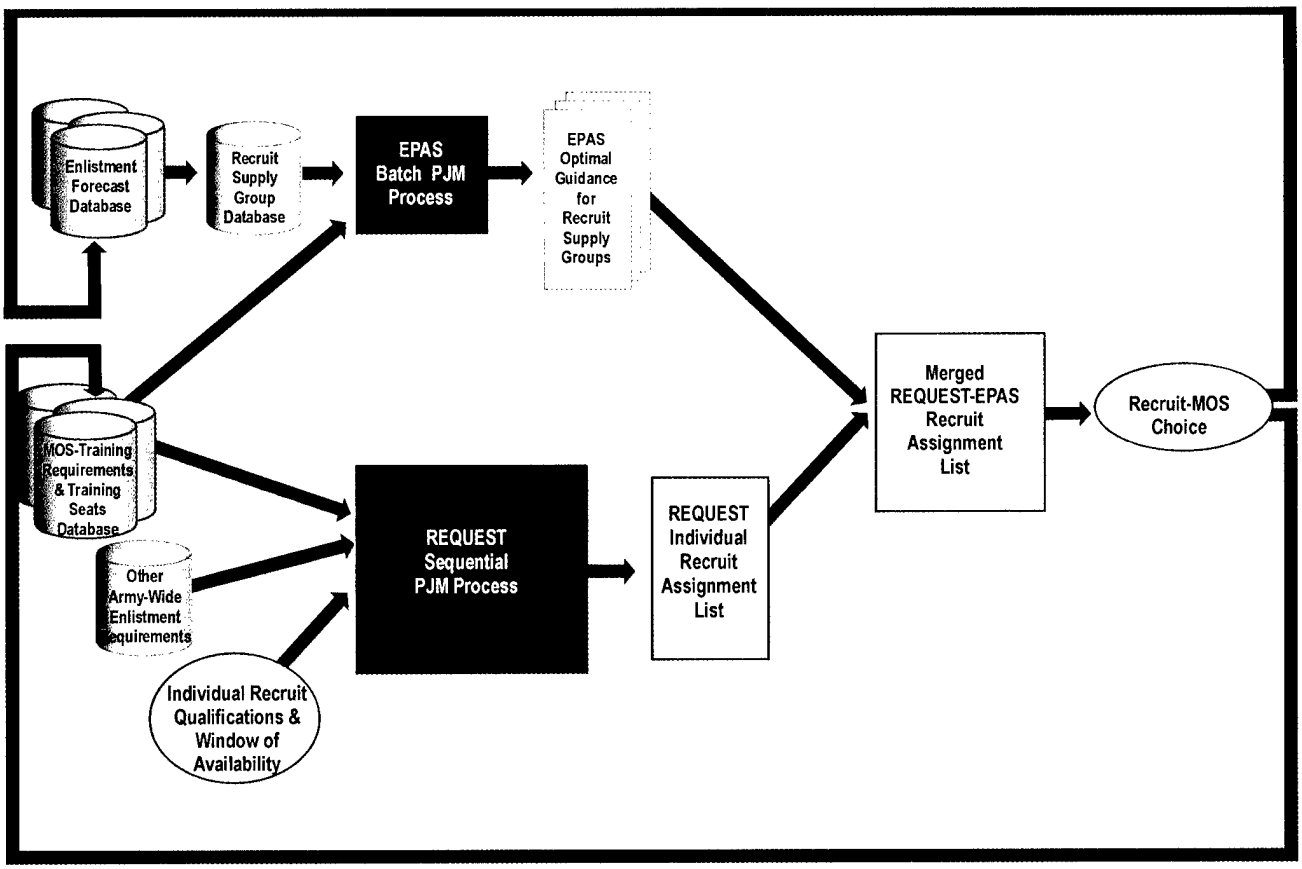


Figure 3
Model of a REQUEST-EPAS Classification System.

The REQUEST Classification System

REQUEST Inputs. The REQUEST inputs include MOS information, most notably the minimum required Aptitude Area composite score and the schedule of entry-level training. Other Army-wide enlistment requirements are also inputs to REQUEST, including designations of critical and hard-to-fill MOS, equitable distribution of highly qualified recruits across all MOS, and information about the composition of the DEP.

Since REQUEST produces a list of 25 MOS training assignments tailored to each recruit, it requires that the individual recruit's qualifications be inputs into the system. These include Aptitude Area composite scores and other specific qualifications needed for entrance into particular MOS (e.g., high school trigonometry). The recruit's window of availability for entrance processing is also a REQUEST input.

The REQUEST Sequential Assignment Process. The REQUEST assignment process evaluates each potential recruit independently in real time to identify MOS for which the individual meets the minimum Aptitude Area composite score qualifications. REQUEST also identifies entry training opportunities, which fall within the recruit's window of availability, for the MOS. The REQUEST sequential assignment and training reservation process is designed to ensure that MOS-training seat recommendations satisfy a number of Army-wide enlistment requirements, which are enumerated above in "How the Army Classification Process Works." Filling high priority MOS is one of the most important requirements.

REQUEST Output: REQUEST Individual Recruit Assignment List. The output is a REQUEST assignment list of 25 MOS training seat opportunities and report dates, which are ordered from highest to lowest in terms of Army enlistment priorities. The 25 possible assignments give recruits a choice of MOS, training classes, and report dates within the window of availability.

THE EPAS SUBSYSTEM OF REQUEST

EPAS Inputs. The batch classification process employed by EPAS requires three input databases, an MOS-Training Requirements Database, a Training Seats Database, and an Enlistment Forecast Database, to generate near-optimal recruit-MOS training assignments. Monthly accession targets and annual training requirements based on inventory projection models are developed by ODCSPER/DMPM. Training requirements drive the class schedules produced by the Training and Doctrine Command (TRADOC); class seats are passed to REQUEST (and hence to EPAS) by the Army Training Requirements and Resources System (ATRRS).

The Enlistment Forecast Database contains monthly contract forecasts for each of 127 empirically created recruit supply groups defined by demographic category and Aptitude Area score profiles. Table 7 shows the decomposition of the expected recruit pool into 13 demographic categories, formed according to gender, education level, and AFQT category, and within these by similarity of profiles.

The variation in the number of supply groups within a demographic category reflects the historical proportion of Army applicants in that category and the extent ASVAB profiles vary within the category. For example, the first demographic group is composed of male, high school graduates with AFQT scores in Categories I-IIIA. Because this group

Demographic Group (DG)			Number of Supply Groups (SG)
Gender	Education	AFQT	
1. Male	High School Graduate	I-IIIA	26
2. Male	High School Senior	I-IIIA	16
3. Female	High School Graduate	I-IIIA	12
4. Female	High School Senior	I-IIIA	8
5. Male	High School Graduate	IIIB	14
6. Male	High School Senior	IIIB	9
7. Female	High School Graduate	IIIB	8
8. Female	High School Senior	IIIB	7
9. Male	Non-graduate	I-IIIA	8
10. Female	Non-graduate	I-IIIA	5
11. Male	Non-graduate	IIIB	4
12. Female	Non-graduate	IIIB	3
13. Male	High School Graduate	IV	7

DG	SG	GM	EL	CL	MM	SC	CO	FA	OF	ST
1	1	95	100	107	92	94	93	100	97	101
1	2	114	117	118	113	116	114	118	115	118
1	3	111	108	107	115	112	113	110	115	111
1	4	...	...	...	...	...	...	...	...	...
1	5	...	...	...	...	...	...	...	...	...

Table 7
Recruit Supply Groups

contains the largest proportion of Army recruits, it accounts for 26 of the 127 recruit supply groups. A large number of supply groups were necessary to adequately represent the diversity of the Aptitude Area composite score profiles in this demographic group.

The EPAS Batch Assignment Process. Recruit supply group forecasts, available training seats, and accession/training requirements fuel the batch process of EPAS, which would be run separately from the REQUEST sequential process. Figure 3 (shown previously) shows both the EPAS and REQUEST software in the center of the diagram.

The EPAS batch process is a linear programming optimization software program that matches forecasts of recruits, categorized by recruit supply groups, to projected MOS training opportunities. Recall that the batch optimization program generates a set of near-optimal recruit supply group/MOS training matches, taking into account that the supply group average Aptitude Area composite scores must meet MOS minimum qualifications.

The matches are ranked from high to low in terms of an EPAS Index of System Efficiency. This index utilizes the "look ahead" capability (across a fiscal year) of the batch process and the current weekly and monthly status of accession goals and MOS training requirements.

Update runs of EPAS can be conducted daily or weekly to freshen assignment lists so they reflect current critical Army enlistment requirements. That said, flexible use of the DEP to efficiently manage the optimality of assignments by regulating entrance dates is a powerful tool for taking advantage of the EPAS near-optimal batch process. Efficient management of the DEP is often difficult in restricted recruiting markets. But this is an area where real-time investigation of procedures for coordinating the REQUEST and EPAS assignment processes could pay important long-range dividends to the Army. Of course, this would require close, careful monitoring of assignments and the DEP.

Although REQUEST has the main task of meeting high priority Army-wide enlistment requirements (e.g., balancing the distribution of highly qualified recruits across all MOS and meeting critical and hard-to-fill MOS needs), the EPAS algorithm includes these factors as constraints in its optimization program. This design feature helps to ensure the greatest possible overlap between EPAS and REQUEST outputs.

EPAS Output: EPAS Optimal Guidance. EPAS produces a separate list of MOS training assignments for each of the 127 recruit supply groups. This list is called the EPAS Optimal Guidance. Since EPAS would be updated daily or weekly, the guidance would weight current Army enlistment needs most heavily. However, it also accounts for the "big picture," which includes the results of assignments already made and the forecasts of enlistments and MOS training requirements for the current and early months of the following fiscal year.

Integrated REQUEST-EPAS Classification System

Merged REQUEST-EPAS Recruit Assignment List. The approach for reconciling REQUEST and EPAS assignment lists is to assign recruits to one of the 127 recruit supply groups based on their demographic characteristics and Aptitude Area composite score profiles. Then the EPAS assignments for the appropriate recruit supply group would be merged with the REQUEST assignments for an individual recruit.

Any EPAS assignments not on the REQUEST list would be dropped from consideration. Then the REQUEST assignments would be rearranged to reflect the EPAS rank ordering. Any REQUEST assignments not on the EPAS list would be placed at the bottom of the merged REQUEST-EPAS Recruit Assignment List in the priority order found in the REQUEST list.

Recruit-MOS Choice. When the career counselor receives the Merged REQUEST-EPAS Recruit Assignment List, he or she would work with the recruit to choose a specific MOS training assignment and report date. The counselor would review the assignments with the recruit, and try to persuade the individual to choose an assignment from the top of the list. In general, the higher the assignment choice is on the list, the better it will match recruit capabilities to job requirements (based on Aptitude Area composites that estimate success in training and on the job) and meet other Army-wide enlistment requirements.

The career counselor should emphasize to the recruit that the merged REQUEST-EPAS assignment recommendations balance the recruit's work-related aptitudes with the Army's practical enlistment needs. This will increase the potential for achievement in entry-level training and success on the job, and will lay the foundation for future growth leading to career progression. When a recruit cohort is taken as a whole, the hybrid REQUEST-EPAS assignment process is expected to produce assignments which raise the aggregate Aptitude Area composite score across MOS and meet critical Army enlistment requirements.

Continuous Enlisted Personnel Classification System Updating. Once a recruit makes an entry-level MOS choice, this information would be fed back to the REQUEST server, which would update the MOS-Training Requirements Database and Other Army-Wide Enlistment Requirements. In addition, updates of EPAS guidance based on the revised requirements would be run daily or weekly.

Second Generation Improvements to EPAS and REQUEST

The ARI researchers and contractors who designed and built EPAS used the existing Aptitude Areas, Aptitude Area composites, and MOS minimum qualifications included in present-day REQUEST. This was done to minimize the extent of change required of REQUEST operators and career counselors (as well as of Army planners, managers, and other stakeholders). However, second generation improvements to EPAS and REQUEST have already been designed and tested in laboratory settings.

The first improvement is a new, larger set of Aptitude Areas that more accurately reflects the similarities and differences in MOS ASVAB profiles than does the present set of nine Aptitude Areas. The present system was developed in 1950, and only slightly revised in 1972. The substantial changes in the structure of MOS and the mission of the Army since 1950 make new Aptitude Areas sorely needed. The second improvement is a new set of Aptitude Area composites that reflect the latest personnel measurement techniques for using aptitude tests to predict performance in training and on the job. The existing composites are overly simplified and, thus, only moderately effective for classification.

ARI has developed new Aptitude Areas and Aptitude Area composites that are currently available for evaluation by the DCSPER, PERSCOM, and TRADOC, field testing, and operational implementation. In laboratory simulations, the second generation improvements to EPAS showed substantial gains in Army-wide productivity compared to the current Aptitude Areas and composites. The improvements could be implemented almost immediately, requiring only a short-term project to establish equivalent MOS minimum qualifications.

Conclusion

The Army and other Services confront unique employment challenges on an on-going basis—how to select from thousands of applicants those who are most likely to succeed in training and on the job, and how to determine (with efficient classification procedures) in which jobs they are most likely to be successful. The classification question is especially complex because most applicants have little in the way of training or work experience that can be used to guide the process.

The Army has used vocational aptitude tests and other measures of work-related personal characteristics to select soldiers who can be efficiently trained and to make job assignment decisions as far back as World War I. Over the years, the knowledge and experience gained by ARI researchers, school proponents, and field commanders has led to the development and refinement of the ASVAB and the investigation of a wide array of other types of enlistment instruments.[16] At the same time, the increasingly diverse and technical nature of Army jobs, and the complexities of the recruiting process for the all-volunteer force, have compounded issues surrounding effective classification.

EPAS represents the culmination of many years of classification R&D by ARI and encompasses some of the newest techniques in personnel testing and automated person-job matching processes. EPAS is designed to be a subsystem of REQUEST that improves the quality of recruit-MOS matches, thereby raising aggregate Aptitude Area composite scores.

ARI will be field testing the operational version of EPAS in FY 2001. While existing laboratory findings are strong, the results of the EPAS field test are needed to establish whether the findings will be realized in the dynamic, operational environment of Army recruiting and enlistment. To preserve the integrity of the Army's selection and classification processes, the field test will be conducted using sophisticated statistical and realistic simulation techniques to make it non-intrusive. The field test findings will be ready for evaluation in FY 2002.

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[4] The DoD has agreements with scores of high schools around the country to administer the battery and a vocational interest inventory to juniors and seniors. The program materials also include questions about work-related personal preferences (e.g., educational aspirations) and work values. The program has a dual purpose—to provide quantitative and qualitative information to help high school guidance counselors and students with career decision-making, and to identify young people who are qualified for military service. It tests approximately one million students a year.

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Peter M. Greenston, Contracting Officer's Representative

14. ABSTRACT (Maximum 200 words):

This U.S. Army Research Institute (ARI) Special Report on the Enlisted Personnel Allocation System (EPAS) presents the history and current status of the Army's enlisted personnel selection and classification system. It is written for policy-makers, managers, and human resources personnel. The report includes a discussion of the theoretical and practical aspects of selection and classification testing in the context of Army operations dating back to World War I. EPAS, the optimal person-job matching software developed by ARI, is described along with its potential to improve the effectiveness of the Army's classification system.

15. SUBJECT TERMS

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